

Scientists, Scientific Societies, and the Armed Forces

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THE RECENT PUBLICATION by the Department of the Army of the booklet *Scientists in uniform, World War II* was followed by a small flurry of editorial comment. Although the booklet was published by the Army, it is based on data obtained from scientists who had served in all branches of the armed forces. This renewed interest in the problem of the scientist's place in the National Military Establishment apparently was short-lived and resulted in no really significant action either on the part of the military or on the part of science. It is difficult to understand the apparent disregard of this critical summary of the experiences of a great number of scientists, which offered many lessons. These experiences should inspire an intensive effort to correct what are apparently self-admitted deficiencies. By this time, however, it is evident that the effort will not arise spontaneously within the armed services. If it is to be made, the effort will have to come from those scientists who provided the material on which the booklet was based, acting together with their fellow scientists, both as individuals and through their collective media—the scientific societies.

Is this problem important enough to warrant some concerted action on the part of scientists? The evidence indicates that such action is not only desirable but actually fundamental to successful national defense. Even the layman saw how dependent the armed services were upon scientific advances during the war. Now that the war is over new weapons are still essential to successful national defense, and only scientific research can produce them. Many more facts point up the importance of good relations between science and the military. We have a large military establishment, which is continuing its war-born policy of supporting research. This country is assuming increased international responsibilities. In the event of another war an attack on the continental areas of the United States is almost certain. These are all reasons for establishing an efficient scientific organization within the services.

One might well inquire next whether science would be justified in attempting to establish within the armed services those conditions that are so well recognized as being essential to fruitful research. In this con-

nection, the scientist should bear in mind that he has a dual responsibility, the first being his responsibility as a citizen of the United States, and the second his acknowledged indispensability in the development and application of new weapons, techniques, and operational methods. In answer to this inquiry, it cannot be overemphasized that the armed forces are the stewards of the people in regard to military affairs. The services are under civilian control, as has been well demonstrated. It therefore becomes a duty of every citizen, and particularly of every scientist, not only to support the armed services but also to scrutinize their actions, criticize where necessary, present constructive suggestions as needed, and finally to determine whether these suggestions have been adopted. What section of the citizenry is better qualified to carry out these duties, where scientific policies are involved, than the scientific segment?

Once the importance of the problem of science in the armed services is established, and the duty of the scientist in regard to the problem, two more questions present themselves. First, are the military services dealing adequately with this problem? Second, is organized science taking sufficient interest in the actions of the military services?

In answering the first question, one must remember that, in peacetime, the primary mission of the armed services is to prepare for the defense of the nation in the event of war. As has been stated, these preparations must depend upon scientific research to develop and to assist in the application of new weapons, techniques, and operational methods. In order to coordinate the scientific efforts of the National Military Establishment, Congress established the Research and Development Board. The Board's functions are limited to surveying fields of interest to the military for pertinent scientific discoveries, and to coordinating research so as to minimize duplication. Unfortunately, the board's authority does not extend to such major responsibilities as selection of scientists, operation of laboratories, establishment of operating policies, planning careers in science, or publication of research. It is difficult to see how the Research and Development Board can ever be completely successful until these duties are assigned to some section of the Military Establishment and are put on an equal basis

with the ones now performed by the RDB. Clearly, there is not now in the Military Establishment any central group discharging these responsibilities.

Although the necessity for establishing such authority was pointed out on numerous occasions before the end of the war, no action was taken. There was widespread dissatisfaction with the place of the scientist in the military at that time, as reflected in the booklet, *Scientists in uniform, World War II*. Testimony to the strength of this dissatisfaction is presented by the precipitous decrease in the number of scientists in the services after V-J Day, in spite of well-equipped laboratories and good salaries. Apparently little has been done to remedy conditions responsible for this dissatisfaction and certainly scientists outside the services have done nothing toward solving the problem.

A few quotations from *Scientists in uniform, World War II* will illustrate the type of problem under discussion and the failure of the armed services to correct the apparent defects: Page 61: "More than one-half of the respondents emphasized the need for better methods of assignment or supervision of technical personnel in uniform. The emphasis varied from 80 percent of the respondents in the field of biology to 35 percent in the fields of geology and psychology." The number of respondents are: biology 2,830; geology 605; psychology 1,168. The percent reporting utilization in primary field and at proper level of competence for at least half or more of the time in military service are respectively 34, 27, and 72 percent. Page 13: A chart presents the information that 63.2 percent of the respondents suggested better assignment or supervision. Page 16: "Scientists trained in technical fields whose uses were not thoroughly understood by personnel of the Armed Services tended to be poorly utilized, the opposite was generally true for scientists representing technologies with which the services were familiar. . . . Failure to understand the application of many technical fields to military functions led to a lower efficiency of technical military activities and an inability of scientists to carry projects through to active military application."

These several quotations all refer to assignment and supervision of scientists, and without doubt, these are key factors in the successful utilization of scientists in the services. With the exception of certain of the civilians on the Research and Development Board, however, none of the top rank positions within the three armed services is held by an outstanding scientist. On the contrary, many are held by military men who are poorly trained in science, some of them with no training in science at all. This same condition extends downward to the level of laboratories

and other working facilities. Some of them are sympathetic with the scientists' problems, but the point is that they are not scientifically competent. There are of course exceptions—a few conscientious, competent scientists in various echelons who are doing an excellent job, in spite of difficulties, and who deserve praise and encouragement.

From this and other evidence, such as the failure to establish a section to deal with scientists in the newly appointed Secretary of National Defense's Personnel Board, one is led to believe that the National Military Establishment is not dealing adequately with the problem of science and the scientist in the armed services. One even suspects that scientific possibilities are not fully pursued and that the best efforts of the Research and Development Board must be nullified within the services themselves.

Turning to the second question—whether organized science is taking sufficient interest in the actions of the armed services—one must conclude that it is not. Several branches of organized science have appointed advisory committees to the Department of the Army in recent months, but only at the invitation of the Department, and no such committees have yet waited upon the Secretary of National Defense.

As in prewar years, it has become unfashionable to discuss such matters at scientific meetings. Post-war problems have completely overshadowed them, although they had immediate and personal importance to many scientists who served in the armed services. It is difficult to understand why organized science has not maintained greater interest in problems so important to national defense. Unless the situation is corrected in peacetime, scientists will be faced with the same problems in the next war.

Not only is there apparently great reluctance on the part of organized science to attempt to correct the military situation, but also there is increasing reluctance to accept from the armed services any research contracts that have a security classification. Recently, the president of a leading university stated definitely that his university would not accept such contracts in the future. This attitude has found many adherents and will find many more. I will neither attack nor defend this position, although it is my opinion that research on classified projects in academic institutions is incompatible with academic and scientific ethics. The fact remains, however, that this attitude by academicians, scientists included, only increases their responsibility to see that the armed services are provided with the personnel and facilities necessary to carry out research themselves.

Realizing the failure or inability of the military services to solve the problem properly, and the failure

of organized science to insist on a proper solution, one cannot help but be concerned about the situation. There is ample evidence at hand that the services will not take the necessary action of their own volition. This leaves but one course of action—organized science must reawaken its interest in the military problem. The medical profession, having failed to take similar action in the face of a parallel and long-standing problem, are now faced with a draft. Will a similar crisis be required to stimulate scientists?

In answer to the question, "What can be done?" I make the following suggestions:

1. Committees can be organized within scientific societies to make a thorough investigation of the role of the scientist and science in the armed forces.
2. The services of these committees can be offered to the Secretary of National Defense to investigate the problem and to make necessary recommendations.
3. Standing committees can be established to pro-

vide periodic resurveys and to assist in (or to insist upon) the correction of obvious defects.

4. A mechanism can be established whereby scientific societies and academic institutions may assist the armed forces in obtaining necessary scientific personnel of sufficiently high caliber to meet the needs.

5. A plan for determining the supply of scientific man power in the United States and for using it in time of national emergency can be developed and presented to the President of the United States.

These suggestions are only a few of the many that could be made. Unless scientists take action on these or other suggestions which will aid in resolving this important problem, they will have failed to discharge a public duty and to exercise an important right of citizenship. The costs of such failure will be made clear in the event of a national emergency—a time for implementation of plans, not their preparation, and for use of weapons, not their development.

Infrared Spectra of Tissues

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THE INFRARED SPECTRA of many substances such as proteins (1, 5, 8), amino acids (7, 9), and nucleic acids (2, 3) extractable from tissue have been determined. The purpose of the present investigation is to examine the infrared transmission of whole tissue sections of various types with a view toward comparing the data. In this paper we are reporting some measurements of the infrared spectra of tissue sections and blood smears.

The technique used for determination of the spectra consists of mounting the tissue sections (4 to 50 μ thick) directly on thin (0.060-in.) disks of silver chloride without the use of cover slips. If paraffin sections are used, the paraffin is removed by immersion in xylene and washing two or three times in absolute alcohol. A drop of oil is then placed on the section and spread as evenly as possible over it before measuring the spectrum. The use of such a liquid is desirable in order to reduce scattering by the

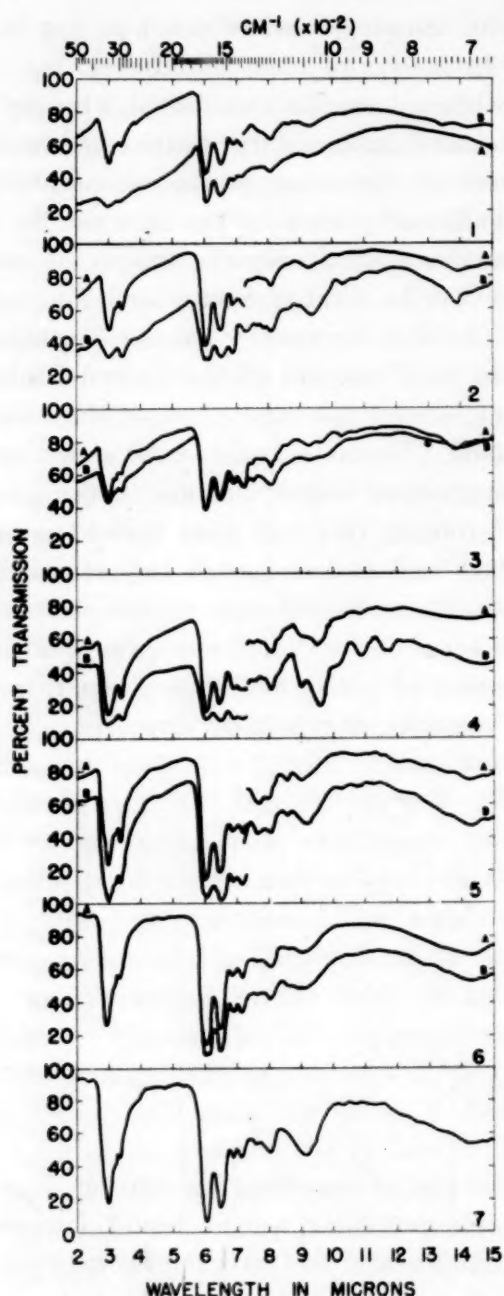
tissue, especially at wavelengths shorter than about 5 μ . A high molecular weight liquid fluorocarbon³ has been found useful for wavelengths between 1 and 7.3 μ , since thin layers of it are completely transparent in this region. For the portion of the spectrum between 7.3 and 15 μ a hydrocarbon (mineral) oil is satisfactory in spite of its slight absorption at 13.8 μ . In all measurements a comparison silver chloride disk coated with approximately the same thickness of oil is used. The tissue section adheres strongly to the silver chloride through these manipulations, and is then ready for measurement in the spectrometer. We use a Perkin-Elmer instrument (model 12A) and place the sample close to the slit. Because the sample is not placed directly at the slit, it is desirable that the tissue area selected for measurement be approximately 17 by 5 mm (slightly larger than the slit size).

In all the spectra shown in Figs. 1-5 there are several strong absorption bands which may be correlated with those of known chemical groupings, viz., 3.04 μ (3290 cm^{-1}), N-H stretching; 3.4 μ (2940 cm^{-1}),

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³Perfluoro lube oil (E. I. du Pont de Nemours & Co.), bp 130-150° C/10 mm, n_D^{20} 1.335. The relatively low refractive index is a disadvantage.



FIGS. 1-7. Infrared spectra of tissues. 1—Carcinoma of bladder, 18- μ section, formalin-fixed paraffin-embedded. Curve A, section with the paraffin removed; curve B, section obtained with the addition of a drop or two of the proper oil. The reduction in scattered light with consequent better definition of the absorption bands, especially at short wavelengths, is apparent. 2—Human mammary carcinoma, formalin-fixed. Curve A, 10- μ section; curve B, 50- μ section. 3—Curve A, human mammary fibroadenoma, formalin-fixed, 20- μ section; curve B, normal human breast, formalin-fixed, 20- μ section. 4—Human mammary carcinoma, fresh frozen, dehydrated tissue. Curve A, 20- μ section; curve B, 50- μ section. 5—Human peripheral blood smears, air-dried. Curve A, normal; curve B, acute leukemia. 6—Histone. Continuous film on silver chloride. 7—Ribonuclease. Continuous film on silver chloride.

C-H stretching; 6.00 μ (1670 cm^{-1}), C-O stretching; 6.52 μ (1535 cm^{-1}), amide bending; and 6.88 μ (1450 cm^{-1}), C-H bending. The consistent appearance, except in the frozen, dehydrated sections, of a slight inflection point at 3.26 μ (3070 cm^{-1}) indicates that it may be the N-H band recently pointed out by Sutherland (1) in certain polypeptides. In addition a band at 8.06 μ (1241 cm^{-1}) to which a definite assignment has not been made, is apparent in all the spectra. The presence of these bands suggests that the main ab-

sorbing constituent is protein in nature; and comparison of the spectra of the tissue sections with that of a histone film (Fig. 6) and a film of ribonuclease (Fig. 7) shows correspondence of the strong bands. The infrared spectra of other proteins from animal and fish sources show similarity in the bands at wavelengths shorter than 6.6 μ , but divergence at longer wavelengths.

In general it is at wavelengths longer than 7 μ that differences due to composition, and to different proportions or arrangements of component groups, should appear. For example, the band at 9.20–9.35 μ seen in all the fixed tissue sections does not appear in the blood smears, whereas two bands apparent in the blood spectra at 8.55 and 9.05–9.15 μ are absent from the tissue curves. Whether the shift of the 9.05- μ band in the normal blood smear to 9.15 μ in the leukemic blood smear is significant is not known at present. Another point that is worthy of note in the spectra is the increased intensity of the 9.3- μ band in the cancerous mammary tissue in Fig. 2 (out of proportion to thickness) as compared with the normal breast tissue (Fig. 3). This band lies at the same position as one of the strong ones in the nucleic acid spectra (3), and it is probable that this increase in absorption is due to an increased amount of nucleic acids in the rapidly proliferating and more cellular carcinoma. Of particular interest is a comparison of the infrared spectra of fixed (lipid-extracted) tissue with fresh frozen, dehydrated tissue. This comparison is perhaps best made between curves 2B and 4B, which are spectra of 50- μ sections of human breast carcinoma. Several absorption bands which appear in the frozen section at 9.00 μ (1111 cm^{-1}), 10.85 μ (922 cm^{-1}), and a doublet at 11.60–11.75 μ (862–851 cm^{-1}) do not seem to have counterparts in the fixed tissue spectra. Also the strong band at 9.55 μ (1047 cm^{-1}) in curve 4B appears to be shifted toward longer wavelengths, if indeed it is the same band (9.20–9.35 μ) seen in the fixed tissue sections.

It is hoped that with the increasing availability of reflecting microscope lenses of the Burch (4) and Grey (6) types, the infrared study of tissues can be extended to cells and portions of cells. Whether infrared techniques will allow an exact differentiation and identification of tissues must await further work.

References

1. ASTBURY, W. T. *et al.* *Nature*, 1948, **162**, 596.
2. BLOUT, E. R. and FIELDS, M. *Science*, 1948, **107**, 252.
3. ———. *J. biol. Chem.*, 1949, **178**, 335.
4. BURCH, C. R. *Proc. phys. Soc., Lond.*, 1947, **59**, 41.
5. DARMON, S. E. and SUTHERLAND, G. B. B. M. *J. Amer. chem. Soc.*, 1947, **69**, 207.
6. GREY, D. S. Paper No. 52, Opt. Soc. Am. Meeting, March 12, 1949, New York, N. Y.
7. HEINTZ, E. *C. R. Acad. Sci., Paris*, 1935, **201**, 1478.
8. VLES, F. and HEINTZ, E. *C. R. Acad. Sci., Paris*, 1937, **204**, 567.
9. WRIGHT, N. *J. biol. Chem.*, 1939, **127**, 137.

TECHNICAL PAPERS

The Effect of Vitamin B₁₂ Concentrate on the Growth of Weanling Pigs Fed Corn-Soybean Diets¹

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In experiments with chicks, Ott, Rickes, and Wood (2) have shown that crystalline vitamin B₁₂ gave a growth response comparable to that obtained with crude sources of the "animal protein factor." Johnson and Neumann (1) have obtained growth stimulation from a vitamin B₁₂ concentrate fed to suckling pigs.

The present experiment was undertaken to determine whether crude vitamin B₁₂ concentrate exhibited a growth-stimulating effect in weanling pigs fed a diet in which the protein source was entirely of plant origin.

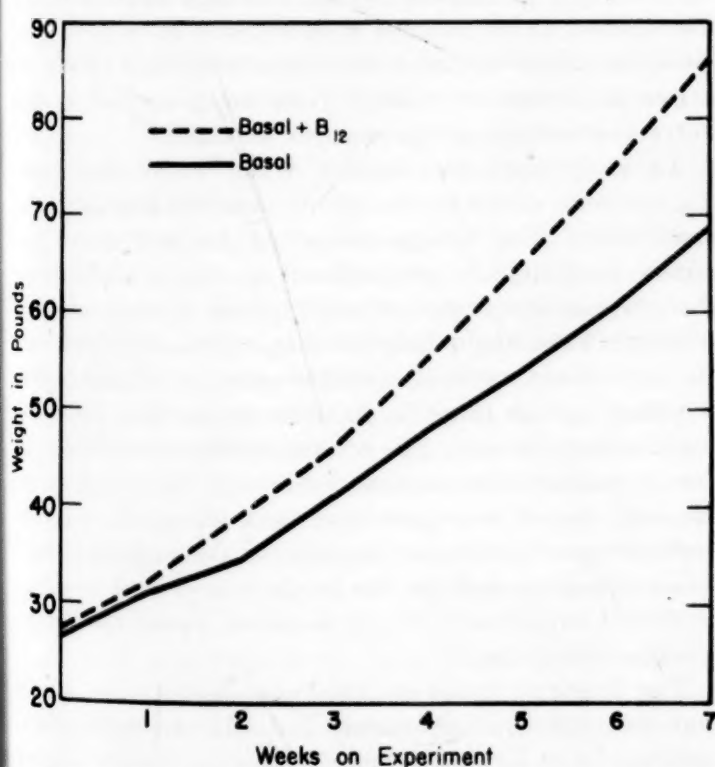


FIG. 1. Effect of vitamin B₁₂ concentrate on growth rate.

The pigs used in the experiment were farrowed by Chester White gilts which had never been fed any known source of the "animal protein factor." At the time of weaning, 12 pigs were selected and divided into two lots of six pigs each. The basal ration was the same as that fed to the gilts during their growth, gestation, and lactation.

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tation period and contained corn, 77%; soybean oil meal, 20%; and a complex mineral mixture, 3%. This ration was supplemented with the following B vitamins expressed in mg per lb of feed: thiamine, 5; riboflavin, 5;

TABLE 1
EFFECT OF ADDITION OF VITAMIN B₁₂ CONCENTRATE
TO A CORN-SOYBEAN DIET

| | Lot 1 (Fed basal ration) | Lot 2 (Fed basal ration + vitamin B ₁₂) |
|-------------------------------------|-----------------------------------|--|
| Number of pigs | 6 | 6 |
| Initial age in weeks | 6 | 6 |
| Number of weeks on trial | 7 | 7 |
| Average initial weight (lb) | 26 | 27 |
| Average daily gain (lb)* | 0.87 ± .09 | 1.20 ± .08 |
| Average daily feed consumption (lb) | 2.57 | 3.21 |
| Lb of feed per lb of gain | 2.94 | 2.65 |

* Difference in average daily gain between lots 1 and 2 is statistically significant.

calcium pantothenate, 20; niacin, 25; and pyridoxine, 2. Choline chloride was also added at a level of 0.1%. Vitamins A and D were added to the ration in amounts which supplied 2,000 I.U. of vitamin A and 200 I.U. of vitamin D per lb of feed. This ration contained 16.5% crude protein by Kjeldahl analysis. All of the pigs in the experiment were fed *ad libitum*. The pigs in lot 1 were fed the basal ration and their growth response is shown in Fig. 1 and in Table 1. The pigs in lot 1 gained an average of 0.87 lb per day and consumed 2.57 lb of feed. It required 2.94 lb of feed to produce a 1-lb gain in body weight.

The pigs in lot 2 were fed the same ration as those in lot 1, but in addition, this ration was supplemented with 0.5% vitamin B₁₂ concentrate. The vitamin B₁₂ concentrate had been assayed in comparison with crystalline vitamin B₁₂ and the preparation standardized to contain 2 mg of vitamin B₁₂ activity per lb as measured by the chick-growth method. The growth curve for the pigs in this lot is shown in Fig. 1. It can be seen that as the experiment progressed, the differences in rate of gain between pigs in lots 1 and 2 became significantly greater, and by the end of the seventh week pigs in lot 2 averaged 17 lb heavier than animals in lot 1. Table 1 shows that pigs in lot 2 gained an average of 1.20 lb of body weight and consumed an average of 3.21 lb of feed per day. The animals in lot 2 utilized their feed more efficiently since it only required 2.65 lb of feed to produce a 1-lb gain in body weight as compared with 2.94 lb of feed for pigs in lot 1. From a practical standpoint the growth rate of pigs in lot 2 was excellent, especially since the protein content of the ration is considerably lower than one would recommend for pigs of that age.

and weight. It seems valid to conclude, therefore, that the significantly greater gains made by pigs in lot 2 were due to the addition of vitamin B₁₂ concentrate. However, since this preparation undoubtedly contains impurities, it cannot be stated definitely that the growth-promoting activity of the concentrate was due to vitamin B₁₂ *per se*, although the latter hypothesis seems likely.

References

1. JOHNSON, B. C. and NEUMANN, A. L. *J. Animal Sci.*, 1948, 7, 528.
2. OTT, W. H., RICKES, E. L., and WOOD, T. R. *J. biol. Chem.*, 1948, 174, 1047.

A Technique for Chronic Remote Nerve Stimulation¹

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Chronic remote nerve stimulation is the usual terminology applied to a technique whereby a nerve in an intact animal is stimulated for periods of weeks or months by an electrical current, the ultimate source of which is removed from and not connected to the animal. By this method the effect of stimulation of a specific nerve in unanesthetized, intact animals can be assayed, thus eliminating disturbing emotional factors due to restraint. Chronic remote nerve stimulation permits close imitation of normal and certain abnormal physiological states.

Various methods for attaining remote stimulation have been tried in the past. Loucks (12), and Chaffee and Light (2) reported techniques in which a secondary coil was buried beneath the integument, leads from this being connected to electrodes on given nerves. A primary coil positioned over or around the buried unit induced a current in the secondary coil. High currents are required in the primary circuit to induce adequate currents in the secondary. This proves cumbersome and inefficient. These disadvantages can be partially offset by restraining the animal and closely approximating the two coils as Harris (9) is doing. However, since restraint of the animal must be employed, such techniques eliminate many of the desirable features of chronic remote excitation. Its great advantage over systems of chronic stimulation by means of lead wires brought out through the skin, as utilized by Hess (10), Cannon (1), Manning and Hall (13), Cressman and Blalock (3), Kottke, Kubicek, and Visscher (11), is that there is no possibility of infection traveling down the leads. This method also restricts the wave form of the stimulating voltage developed across the secondary coil.

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Newman, Fender, and Saunders (14), and Greig and Ritchie (8) have reported success using radiofrequencies to provide an electromagnetic field for exciting the buried secondary coil. Fender utilized a frequency of 430-ke while Greig and Ritchie employed a 100-ke frequency. Along with other technical difficulties, polarization at the stimulating electrodes and broken lead wires due to intra-animal motion were the major factors in preventing the attainment of chronicity. Fender (4-7) did report one period of 5½ months of successful splanchnic stimulation but broken leads and polarization were always major handicaps in his experiments.

For the past year we have had in operation a system of remote stimulation utilizing radiofrequency for transmission of the signal to the receiver. Detailed studies of polarization with various wave forms have been made. Buried units have been devised and subjected to all the traumata possible in unanesthetized, unrestrained animals. Following is a description of the system which has met our minimal standards of chronicity and remoteness, i.e., stimulation over periods of 4 months in a cage 8 ft. in diam.

The receiver circuit consists of a flat pickup coil tuned to resonate at 1 megacycle by a condenser connected in parallel with it. The r-f voltage output from this is rectified by a germanium crystal and then applied to the nerve which is to undergo stimulation. A by-pass condenser is connected across the output terminals of the receiver to prevent r-f voltage from being applied to the nerve and to increase the receiver sensitivity.

An analysis of the receiver circuit shows that there are optimum values of the circuit elements for maximum sensitivity. The voltage output of the coil under optimum conditions is proportional to the 3/2 power of the coil diameter and to the 1/2 power of the radiofrequency. This would indicate that, within the limits of the experiment, optimal conditions may be obtained with a pickup coil as large in diameter as possible and of a high radiofrequency. The crystal rectifier should have as low a resistance as possible. The number of turns on the coil should be adjusted so that the product of its inductive reactance and *Q* is equal to the equivalent load resistance presented by the nerve and crystal rectifier. Sufficient capacitance should be added across the coil to produce resonance.

Two types of receivers were constructed: one was a flat disk with a single pickup coil and the other was a sphere with three coils mounted mutually at right angles. The flat receiver is used in experiments where the subject is held fixed for a time in such a position that the receiver coil is properly oriented with respect to the r-f magnetic field. The exciting field may be induced by a large primary coil which entirely surrounds the subject or by a small coil held in close proximity to the receiver. The spherical receiver is essentially three separate receivers with their output terminals connected in parallel. By mounting the pickup coils mutually at right angles the receiver will respond to an r-f magnetic field in any direction. With this receiver the subject may move around freely within a single primary coil 6-10 ft in diam and receive nearly uniform stimulation at all times.

Flat single coil receivers which operate at a radio-frequency of 1 megacycle are made as follows: The coil is made by winding $17\frac{1}{2}$ turns of number 26 AWG enameled copper wire on a form $\frac{3}{4}$ in. diam and $\frac{3}{16}$ in. wide. The coil is painted with collodion to hold the turns together before removing from the form. Next a 2,500 mmfd resonating condenser, germanium crystal, and 3,000 mmfd by-pass condenser are mounted inside the coil. The electrode and ground leads are then attached to the circuit. The circuit is cast into a plastic disk of polyethylene. The ground plate is a tantalum or silver disk $\frac{3}{4}$ in. in diam and 0.02 in. thick with edges rounded and smooth.

The leads used in connecting the electrode and ground plate to the receiver are of the utmost importance. Flexible conducting leads have been made by overwinding a thread 0.015 in. in diam with two copper ribbons 0.0005 in. thick and 0.02 in. wide. The lead is insulated by covering with polyethylene tubing which has an 0.023-in. bore and an 0.014-in. wall thickness.

The electrode which wraps around the nerve is made from 0.002-in. silver foil $\frac{1}{4} \times \frac{3}{8}$ in. This is attached to the flexible lead by inserting the lead and a small wedge of silver foil into a small metal tube and then crushing the tube. The electrode is covered on the outside by 0.118 in.-diam polyethylene tubing $\frac{1}{2}$ in. long which has been cut lengthwise so that the nerve can be inserted. The side of the tubing opposite the cut is pierced in the center to permit passage of the conducting lead and is fused to the end of the tube covering the lead. The other end of the tubing is fused to the polyethylene disk covering the receiver.

The three-coil spherical receiver is made in the same way as the single-coil receiver except that the coils are not cast in solid polyethylene but two hemispherical shells are placed around them and fused together. This makes a lightweight covering which is moisture proof.

There are many advantages to the use of radiofrequencies for transmitting the signal to the receiver and then applying the rectified output of the receiver to the nerve. Relatively low power equipment can be used. The stimulating voltage applied to the nerve can be made to have practically any wave form by proper modulation of the r-f transmitter.

In most experiments we have found it desirable to apply rectangular pulses to the nerve. This is accomplished by modulating the transmitter with a square wave generator in which the width, repetition rate, and amplitude of the stimulating pulses can be controlled over a wide range.

Electrode polarization may be made negligible by the use of rectangular pulses. The pulse width is kept very short (a few milliseconds), and the repetition rate is kept well below what appears to be the fatigue level of the neuromuscular junction. Rectangular pulses lend themselves to detailed analysis in determining optimum conditions for efficient and effective stimulation of specific nerves.

Our method has been used to stimulate radial nerves in the forelegs of unrestrained dogs. Functional electrodes

have been maintained *in situ* for 11 months. Buried units have successfully stimulated the front paw via the radial nerve for over $8\frac{1}{2}$ months. Stimulation of the splanchnics and the vagi in the lower thorax has been carried out for similar periods. Studies have been made of the reaction of the nerves to the electrodes. Grossly, there is no scar tissue response to the encompassing electrode, although microscopic sections of the nerves have shown moderate perineural fibroblastic proliferation.

References

1. CANNON, B. *Amer. J. Physiol.*, 1933, **105**, 366.
2. CHAFFEE, E. L. and LIGHT, R. U. *Yale J. Biol. Med.*, 1935, **7**, 83; 441.
3. CRESSMAN, R. D. and BLALOCK, A. *Proc. Soc. exp. Biol. Med.*, 1939, **40**, 258.
4. FENDER, F. *Arch. Neurol. Psychiat.*, 1941, **45**, 617.
5. ———. *Proc. Soc. exp. Biol. Med.*, 1937, **36**, 396.
6. ———. *Amer. J. Physiol.*, 1936, **116**, 47.
7. ———. Personal communication.
8. GREIG, J. and RITCHIE, A. *J. Physiol.*, 1944-45, **103**, 8P.
9. HARRIS, G. W. *J. Physiol.*, 1948, **107**, 416; 418.
10. HESS, W. R. *Beiträge zur Physiologie des Hirnstammes. I. Teil. Die Methodik der lokalisierten Reizung und Ausschaltung subkortikaler Hirnabschnitte*. Leipzig: George Thieme, 1932.
11. KOTTKE, F. J., KUBICEK, W. G., and VISSCHER, M. B. *Amer. J. Physiol.*, 1945, **145**, 38.
12. LOUCKS, R. B. *J. comp. Psychiat.*, 1933, **16**, 439.
13. MANNING, G. and HALL, G. *J. lab. clin. Med.*, 1937, **23**, 306.
14. NEWMAN, H., FENDER, F., and SAUNDERS, W. *Surgery*, 1937, **2**, 359.

Recovery of the Virus of Eastern Equine Encephalomyelitis from Mosquitoes (*Mansonia perturbans*) Collected in Georgia

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Although mosquitoes have long been considered the probable vector for the virus of eastern equine encephalomyelitis (E.E.E.), so far there has been no published account of the recovery of this strain from mosquitoes taken in nature. However, the virus has been isolated from the chicken mite (*Dermanyssus gallinae*), and from chicken lice (*Eomenacanthus stramineus*) as recently reported by Howitt *et al.* (4). Merrill, Lacaille, and TenBroeck (5) had demonstrated earlier that the eastern strain could be transmitted experimentally by several species of *Aedes* (*A. sollicitans*, *A. cantator*, and *A. taeniorhynchus*). They were unable to transmit the virus by *Culex pipiens* or *Anopheles quadrimaculatus*. Davis (1) found that five species of *Aedes* mosquitoes prevalent in Massachusetts, (*A. vexans*, *A. sollicitans*, *A. cantator*, *A. atropalpus*, and *A. triseriatus*) could transmit E.E.E. virus when tested in the laboratory, but no transmissions were obtained from other genera (*Culex*, *Mansonia*, or *Anopheles*). This note is to report on the

¹ From the Virus Branch and Laboratory Division, Montgomery, Alabama.

recovery of the E.E.E. virus from the mosquito *Mansonia perturbans* Walker taken in nature.

During the summer of 1948, a few horses in different parts of Georgia were diagnosed as having encephalomyelitis. The brains from two animals were sent to the U. S. Public Health Service Virus Laboratory in Montgomery, Alabama, where the virus of eastern equine encephalomyelitis was recovered from them. During the same period, mosquitoes were collected from different areas in the state by members of the Epidemiology Division of the U. S. Public Health Service in collaboration with the Georgia State Department of Health. Forty-three *Mansonia perturbans* were taken from farms in Burke and Jenkins Counties, where sick horses previously had been reported. These mosquitoes were put into glass ampules, which were sealed in a flame and then quickly frozen with dry ice and alcohol. They were sent in this frozen state to the laboratory in Montgomery. There they were pooled, washed with buffered saline, suspended in 3 ml of buffered saline containing 30% normal rabbit serum, and spun in the angle centrifuge for 20 min at 13,000 rpm. The supernatant fluid was removed and 0.03 ml was inoculated intracerebrally and 0.1 ml intraperitoneally into nine 12-day-old white Swiss mice. After 2-4 days, three animals died and four became sick and were killed. The brains were removed but, because of a bacterial contamination, the suspension of brain tissue was passed through a Seitz filter before inoculation of a second group of mice. The latter animals either died or showed typical convulsions in 2-3 days. Cultures of the brains were negative for bacteria, so that a third passage was made to mice. All of these animals either died or showed symptoms of an acute encephalitis. In a further passage the titer was 10^8 in mice.

This virus was then identified as that of the eastern equine encephalomyelitis strain, both by means of the neutralization test in mice and by cross immunity inoculations into immune guinea pigs. The virus was neutralized by the E.E.E. antiserum but not by that of the W.E.E. or St. Louis strains. Guinea pigs, previously proven immune to the stock E.E.E. strain by intracerebral inoculation of 70,000 lethal mouse doses of virus, withstood a dose of the new strain that was fatal for the control animals and for those immunized to the western equine virus. Moreover, an antigen prepared from a mouse brain suspension of this virus gave a positive complement-fixation against E.E.E. antiserum but not against those of the W.E.E. or St. Louis strains. The antigen titer was 3+ in a dilution of 1:32 against the E.E.E. serum.

It should be stated here that the Venezuelan equine virus has been recovered by Gilyard (2, 3) from another species of the genus *Mansonia* (*Mansonia titillans*) taken in nature in Trinidad. Both *M. titillans* and *M. perturbans* are persistent feeders on warm-blooded animals, including horses and chickens. This makes these mosquitoes potentially dangerous vectors of equine encephalitis viruses if they are true vectors, rather than merely transient carriers. Further studies to establish the role of *M. perturbans* in the epidemiology of eastern equine encephalitis are planned for the coming season.

In summary, a filterable virus, proven to be antigenically and immunologically identical with that of the eastern equine encephalomyelitis virus, has been recovered from wild-caught specimens of *Mansonia perturbans* Walker. The infected pool of these mosquitoes was collected in Burke and Jenkins Counties, Georgia during the summer of 1948.

References

1. DAVIS, W. A. *Amer. J. Hyg.*, 1940, **32**, 45.
2. GILYARD, R. T. *U. S. Army Med. Dept. Bull.*, 1944, **75**, 96.
3. ———. *J. Amer. Vet. med. Ass.*, 1945, **106**, 267.
4. HOWITT, B. F., et al. *Proc. Soc. exp. Biol. Med.*, 1948, **68**, 622.
5. MERRILL, M. H., LACAILLADE, D. W., JR., and TENBROECK, C. *Science*, 1934, **80**, 251.

A Convenient Microsyringe

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An accurate microsyringe is useful for dispensing minute quantities of fluids in laboratory experiments. This type of instrument was used for inoculating individual honeybee larvae in the honeycomb by adding spores of *Bacillus larvae* to the food in which the larvae float during the first two days of life (1, 2). Recently it has been improved to increase its accuracy and convenience, and has been used for feeding minute quantities of DDT suspended in 50% sugar syrup to individual adult worker bees. By this method as little as 1 μ g or less of DDT can be fed to each bee. The unit of discharge is 1 μ l.

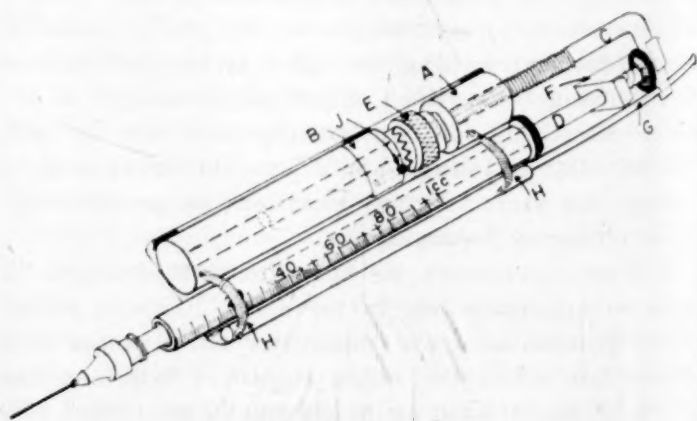


FIG. 1.

The complete instrument is diagramed in Fig. 1. The syringe is a 1-cc glass tuberculin type hypodermic syringe, the 1-cc calibration occupying a linear distance of 56.5 mm. The syringe holder is made of sheet brass formed to accommodate and hold the syringe in position. Two bushings, A and B, serve as bearings to guide the 3/16-in. feed screw C, which regulates the movement of the plunger D of the syringe. The screw is threaded 3/16-32. The feed device E is a knurled nut tapped to fit this screw, and on one end are cut notches or gear teeth. A hole is drilled

in the bushing *B* under the teeth of the nut to accommodate a 5/64-in. steel ball *J* with a coil spring placed under it. The ball enters the space between the teeth as the nut is turned, resulting in a definite click.

The instrument is held in the right hand and operated by turning the nut with the thumb or forefinger. The syringe holder is cut away so that the nut may be reached from underneath. The clip *F* and a coil spring hold the plunger in position against the screw rod. The rod *G* is firmly attached to the syringe holder and serves as a guide for the screw rod *C* through which it passes.

Two light coil springs *H* attached to the central portion and hooked over two prongs soldered to the outside of the holder serve to hold the syringe firmly in place. The springs are unhooked for removal of the syringe.

With a feed nut of 14 teeth and a 32-thread screw there are 448 clicks per in. of screw, or 997 clicks to the 1 cc occupying a distance of 56.5 mm. This is equivalent to 0.0009965 cc per click or, for all practical purposes, 1 μ l. By proper selection of the number of threads per in. in the screw, the number of teeth in the gear of the nut, and the diameter of the syringe, various sizes of drops may be obtained. The quantity of dissolved or suspended materials for a given dose may be calculated on this basis.

A fine long needle of 25 or 27 gauge, cut off bluntly, has been used for the small drops fed to bees. For accuracy it is essential that all air be removed from the syringe and that the temperature remain constant.

References

1. WOODROW, A. W. *J. econ. Ent.*, 1942, **35**, 892.
2. WOODROW, A. W., and HOLST, E. C. *J. econ. Ent.*, 1942, **35**, 327.

The Caries-producing Capacity of Starch, Glucose, and Sucrose Diets in the Syrian Hamster

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The reports of experiments with the cotton and albino rat, in which various carbohydrates were incorporated in the diets to determine their relative cariogenic effectiveness, are either inconclusive or inconsistent (2, 6, 7, 8).

It has been shown that the Syrian hamster on a high carbohydrate diet will readily develop gross lesions of the teeth which are comparable to human dental caries (1, 4), and the use of this animal seems to have several advantages over that of the rat (5). An experiment was designed, therefore, in which the hamster was used for testing the caries-producing capacity of a monosaccharide, a disaccharide, and a polysaccharide.

Sixty-two hamsters (36 males and 26 females) were divided into three main groups with as nearly equal sex and littermate distribution as possible. At the initiation of the experiment, the ages of the animals ranged between

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31 and 34 days. Beginning at this age, each of the three groups received diets which varied in composition only in the type of carbohydrate present. Group I received the following diet: raw cornstarch, 61%; whole powdered milk, 35%; powdered alfalfa, 3%; sodium chloride, 1%. In the diet of group II, the 61% cornstarch was replaced by an equal quantity of powdered α -glucose, and in the diet of group III, the starch was replaced by sucrose in the form of confectioner's sugar.

TABLE 1
CARIES SCORES ON CARBOHYDRATE DIETS

| | No. of animals | Mean caries score | Standard deviation | Critical ratio Starch | Critical ratio Sucrose |
|-------------------|----------------|-------------------|--------------------|-----------------------|------------------------|
| Starch diet | | | | | |
| Males | 12 | 2 | 7 | .. | 9 |
| Females | 9 | 0 | 0 | .. | 11 |
| Glucose diet | | | | | |
| Males | 12 | 72 | 35 | 7 | 5 |
| Females | 8 | 44 | 27 | 4 | 7 |
| Sucrose diet | | | | | |
| Males | 12 | 163 | 57 | 9 | .. |
| Females | 9 | 170 | 42 | 11 | .. |

After an experimental period of 111 days, the animals were sacrificed, the teeth examined under a dissecting microscope, and the carious lesions charted and scored according to the method of Keyes (3). The mean caries scores are shown in Table 1. The difference in mean caries scores of the males on the various diets, and also the difference in the mean caries scores of the females on the various diets, are of a high order of statistical significance.

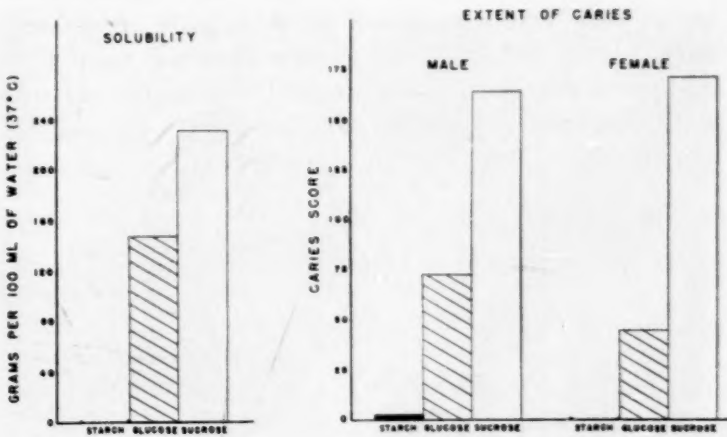


FIG. 1.

Thus it is seen that raw starch plays little if any significant role in the initiation of gross dental caries in the Syrian hamster. The feeding of a diet high in sucrose results in the highest caries scores, whereas a diet high in glucose results in caries scores intermediate between the starch and sucrose groups. Although the severity of dental caries in these three groups is roughly proportional to the solubility in water of the three carbohydrates (Fig. 1), it must not be inferred that solubility is the controlling factor in this experiment. No evidence is available except that cited above and no conclusions

can be drawn at the present time. Further studies are now in progress using a larger number of carbohydrates of different solubility to determine whether such findings hold true in every instance.

References

1. ARNOLD, F. A. *Publ. Hlth. Rep.*, Wash., 1942, **57**, 1599.
2. COX, G. J. *et al. J. dent. Res.*, 1948, **27**, 562.
3. KEYES, P. H. *J. dent. Res.*, 1944, **23**, 439.
4. *Ibid.*, 1946, **25**, 341.
5. KEYES, P. H. and DALE, P. P. *J. dent. Res.*, 1944, **23**, 427.
6. MCCLURE, F. J. *J. dent. Res.*, 1945, **24**, 239.
7. SCHWEIGERT, B. S. *et al. J. Nutrition*, 1945, **29**, 405.
8. SHIBATA, M. *J. exp. Med.*, Japan, 1929, **7**, 247.

Synthesis of Amino Acids in the Rumen

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In 1891 Zuntz (6) presented the view that bacteria in the rumen of animals utilize nonprotein nitrogenous compounds to form protein, which in turn was used by the animals. In recent years it has been conclusively shown that protein is formed in the rumen from dietary urea and ammonium salts. The protein thus formed appears to be of relatively low biological value (3-5) but, to our knowledge, no attempt has been made to measure the amino acid composition of protein synthesized in the rumen.

In the course of studies designed to determine the amino acid requirements of farm animals, samples of diets, rumen material, and excreta obtained from three sheep and two goats fed a purified diet containing urea as the nitrogen source were analyzed for the ten essential amino acids. The animals were fed a diet containing

corn sugar, 25%; cornstarch, 42%; cellophane, 20%; minerals, 5%; lard, 4%; and urea, 4%. Vitamins A and D were fed separately each day, but the B vitamins were not supplied because most of them have been shown to be synthesized in ruminants. After the animals had been on a constant amount of the diet for at least 20 days, collections of urine and feces were made for a 10-day period. Samples of rumen material were obtained by stomach tube at the end of the collection periods.

Lambs fed the urea-containing diet gained an average of 0.23 lb per day, as compared with 0.30 lb for similar lambs fed concurrently a ration containing casein. All animals were in positive nitrogen balance. As an average they stored 1.18 g of nitrogen each day. Biological values, calculated from the nitrogen balance data obtained from these animals and figures reported in the literature (2) for metabolic and endogenous nitrogen gave values of 56 for the diet containing urea and 82 for the casein ration.

The amino acids were determined in the purified diet, rumen material, and excreta by the microbiological technique after hydrolysis.

Hydrolysis was carried out in the autoclave in sealed tubes. Acid (10% HCl) was used for all amino acids except tryptophan. Alkali (5 N NaOH) was used for the latter. Organisms, obtained from the American Type Culture Collection, Georgetown University, Washington, D. C., were used for assay of the different amino acids as follows: *Streptococcus faecalis* #9790 for arginine, threonine, tryptophan, and valine; *Leuconostoc mesenteroides* P-60 #8042 for histidine, lysine, methionine, and phenylalanine; and *Lactobacillus arabinosus* 17-5 #8014 for isoleucine and leucine. The basal medium was the same as that reported in the literature for each organism, with the exception of slight modifications to be reported later (1).

In the analysis of rumen material, inhibition of growth of microorganisms was noted at the higher assay levels. This is being investigated further. The values for synthesis of amino acids in the rumen therefore are minimal.

TABLE 1

AMINO ACID CONTENTS OF RUMEN, FECES, AND URINE SAMPLES; AND DAILY AMINO ACID
BALANCE OF SHEEP AND GOATS FED UREA DIET

| Amino acid | Amino acid content (g/16 g N) | | | | Apparent daily amino acid in g | | | | |
|---------------------|----------------------------------|-------------------|-------|-------|--------------------------------|--------|-----------|-------|-----------|
| | Diet | Rumen material | Feces | Urine | Intake from | | Losses in | | Retention |
| | | | | | Diet | Rumen* | Feces | Urine | |
| Arginine | 0.47 | 3.09 | 3.43 | 0.32 | 0.19 | 1.27 | 0.48 | 0.06 | 0.73 |
| Histidine | 0.13 | 1.44 | 1.27 | 0.12 | 0.05 | 0.59 | 0.18 | 0.02 | 0.39 |
| Isoleucine | 0.00 | 3.38 | 3.72 | 0.31 | 0.00 | 1.38 | 0.52 | 0.06 | 0.80 |
| Leucine | 0.36 | 4.96 | 4.35 | 0.43 | 0.15 | 2.04 | 0.61 | 0.08 | 1.35 |
| Lysine | 0.63 | 5.71 | 5.09 | 0.61 | 0.24 | 2.34 | 0.71 | 0.12 | 1.51 |
| Methionine | 0.08 | 1.62 | 1.48 | 0.09 | 0.03 | 0.66 | 0.21 | 0.02 | 0.43 |
| Phenylalanine | 0.13 | 2.47 | 3.39 | 0.22 | 0.05 | 1.01 | 0.48 | 0.04 | 0.49 |
| Threonine | 0.16 | 3.98 | 4.77 | 0.32 | 0.07 | 1.63 | 0.67 | 0.06 | 0.90 |
| Tryptophan | 0.04 | 0.61 | 0.94 | 0.04 | 0.01 | 0.25 | 0.13 | 0.01 | 0.11 |
| Valine | 0.34 | 3.82 | 4.89 | 0.38 | 0.14 | 1.57 | 0.69 | 0.08 | 0.80 |

* These values were calculated by multiplying the daily nitrogen intakes by the amino acid contents of the rumen material.

On the basis of the assays, the purified diet contained traces of all amino acids studied except isoleucine, even though urea was the only nitrogen source added. The presence of these amino acids in the purified diet appears to be a slight protein contamination from the cornstarch, sugar, and lard. The rumen material contained 9 to 20 times more of the amino acids than the diet fed (Table 1).

From a calculation of the amounts of amino acids furnished by the daily ration it would appear that the losses in feces and urine considerably exceeded the dietary intake. Obviously, this could not be the case because the animals were storing nitrogen and gaining weight. If the amino acid content of the rumen material is used to estimate the amounts available to the animals, a retention of the amino acids is indicated, which would explain the ability of the animals to grow. The fact that the animals have continued to gain in weight on the urea diet, containing no protein, for over 3 months is further evidence of the formation of amino acids.

Similar studies were carried out using a purified diet containing glycine as the only source of nitrogen. Rumen samples from sheep fed the glycine diet again indicated synthesis of the amino acids but at a lower level.

Results of these experiments show that the ten essential amino acids are synthesized in large amounts in ruminants fed urea as the only dietary source of nitrogen.

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References

1. BRIM, MYRON. *The evaluation of some lactic acid producing bacteria in the microbiological assay of amino acids*. Ithaca, New York: Cornell University, 1948.
2. HARRIS, L. E. and MITCHELL, H. H. *J. Nutrition*, 1941, **22**, 167; 183.
3. LOFGREEN, G. P., LOOSLI, J. K., and MAYNARD, L. A. *J. animal Sci.*, 1947, **3**, 343.
4. LOOSLI, J. K. and HARRIS, L. E. *J. animal Sci.*, 1945, **4**, 435.
5. RUPEL, I. W., BOHSTEDT, G., and HART, E. B. *J. dairy Sci.*, 1943, **26**, 647.
6. ZUNTZ, N. *Pflug. Arch. f. Physiol.*, 1891, **49**, 477.

Experimental Amyloidosis in the Guinea Pig¹

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In the course of a pathological study of chronic scurvy, we unexpectedly observed deposits of amyloid in various organs. So far as we know, this is the first report of experimental production of amyloidosis in guinea pigs.

Thirty young guinea pigs were fed scorbutogenic diets for varying lengths of time as shown in Table 1; 12 received the Sherman-La Mar diet as modified by Rinehart (10), and 18 the Crampton No. 5 diet (3). The control animals received 2.0 mg/day ascorbic acid, the acute

¹The opinions expressed in this paper are those of the authors and do not necessarily represent the official views of any governmental agency.

scurvy group none, and the chronic scurvy group 0.2 mg/day. No amyloid was found either in the control or in the acute scurvy animals. Among the chronic scurvy

TABLE 1
EFFECT OF DIET AND ASCORBIC ACID ON AMYLOID DEPOSITION IN GUINEA PIGS

| Diet | Ascorbic acid supplement (mg/day) | Number of animals | Time sacrificed (weeks) | Pathological findings | | |
|----------------|-----------------------------------|-------------------|-------------------------|-----------------------|---------|---------|
| | | | | Inanition | Scurvy | Amyloid |
| Rinehart | 0 | 4 | 4-5 | 0 | acute | 0 |
| | 0.2 | 5 | 9-18 | + | chronic | + |
| | 2.0 | 3 | 1-18 | 0 | 0 | 0 |
| Crampton No. 5 | 0 | 7 | 4-5 | 0 | acute | 0 |
| | 0.2 | 2 | 8 and 14 | + | chronic | + |
| | 0.2 | 5 | 1, 1, 2, 6, 19 | + | + | 0 |
| | 2.0 | 4 | 8-17 | 0 | 0 | 0 |

guinea pigs, amyloid was demonstrated only in those animals which were sacrificed 8 weeks or longer after the beginning of the experiment. Six out of seven animals in this last group showed distinct amyloidosis. The lone exception was that of a guinea pig on the Crampton No. 5 diet, which was sacrificed at 19 weeks following a period of 4 weeks of unexplained clinical improvement.

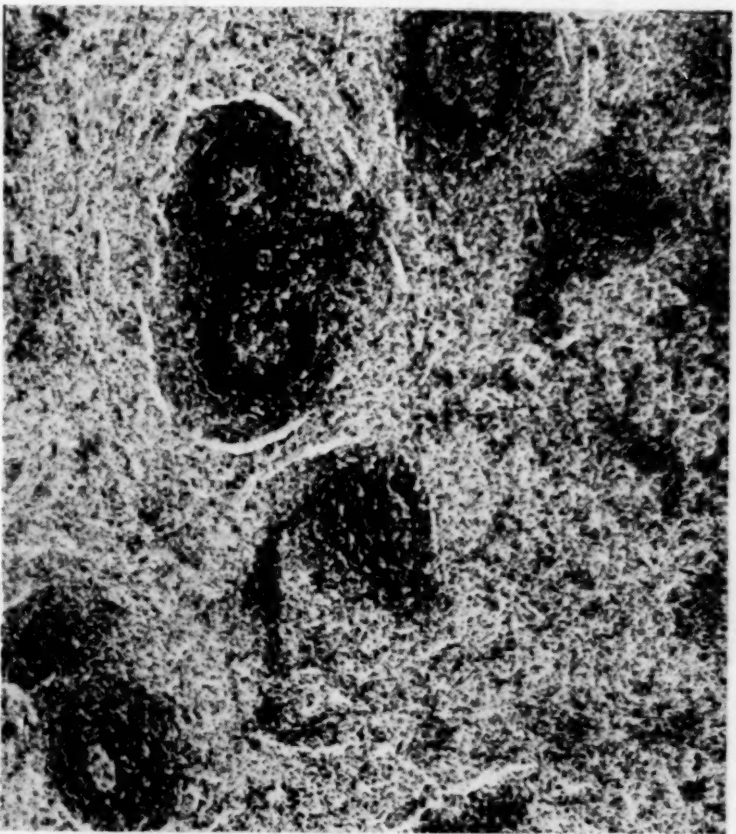


FIG. 1. Spleen from a control guinea pig (hematoxylin-eosin; $\times 65$). Army Institute of Pathology.

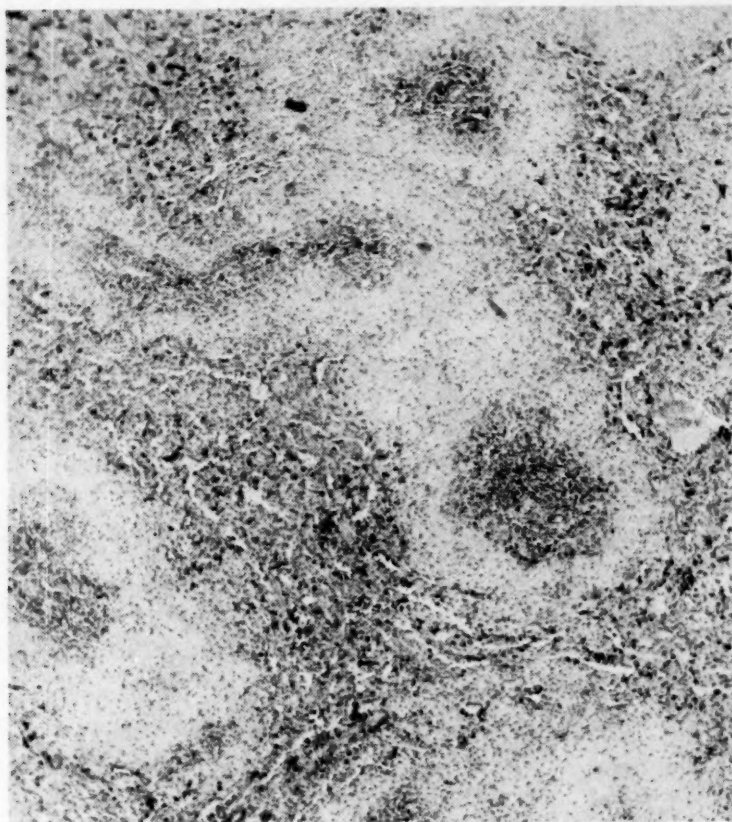


FIG. 2. Spleen from a guinea pig with chronic scurvy (hematoxylin-eosin; $\times 48$). Army Institute of Pathology.

In animals showing amyloid deposition, the spleen was severely involved, the liver moderately, and the adrenal cortex only minimally in a few cases. Amyloid was not found in organs other than those mentioned in the chronically scorbutic guinea pigs.

Microscopically, the amyloid appeared in the spleen in the form of a thick band in the peripheral portion of the Malpighian corpuscles, extending at times to a minor degree into the pulp. (Figs. 1 and 2.) The central portion of the corpuscles appeared normal. The pulp was relatively poor in cells and contained prominent sinusoids. In the liver, amyloid was noted in moderate amounts between the hepatic cords and the walls of the sinusoids. The peripheral two-thirds of the hepatic lobules were as a rule more severely affected, the hepatic cells in these areas appearing small, atrophic, and compressed by the amyloid material. No definite intracellular amyloid was noted in the spleen or in the liver. In the adrenal cortex amyloid was noted in small amounts, again in close apposition with, and at times completely surrounding, the walls of capillaries lying among the cortical cells.

Iodine and sulfuric acid tests on the gross specimens, and crystal violet and Congo red stains on the sections, were all positive. However, the tinctorial response of the amyloid, particularly with Congo red, was not as brilliant as is usually seen in pathological specimens from man. The results of the tests with special stains, together with the typical distribution of the amyloid in the immediate neighborhood of capillaries and of reticulo-endothelial elements, is characteristic of this disease, in both man and experimental animal. The minor differences of the tinctorial response from that usually observed in man can probably be explained on the basis of age of deposition and molecular arrangement of the amyloid.

At the present time the exact chemical composition of amyloid is not known and the etiology and pathogenesis of amyloidosis are not clear. Experimentally, amyloidosis has been produced in mice, rats, hamsters, rabbits, dogs, and horses by various means (1, 2, 4, 5, 7, 8, 9, 11, 13). These include: supplementation of the diet with cheese; injection of bacteria, casein, sodium caseinate, pentose nucleotides, human serum, sulfur, selenium, or sodium silicate; inoculation with *Leishmania donovani*; and implantation of homologous tissues. Allegedly, amyloidosis has also been obtained in the experimental animal by injection of sodium bicarbonate, sodium hydroxide, hydrochloric acid, or animal tar (12). In addition, amyloid has been found in tumor-bearing mice (6).

Our observations do not warrant any positive conclusion, however attractive, as to the possible role of ascorbic acid or inanition, either alone or in combination in the pathogenesis of amyloid deposition. We feel, however, that these observations should be reported for two reasons: because to our knowledge, amyloidosis has never been detected in the guinea pig, and because amyloidosis has never been produced in animals by means of a deficient diet.

References

1. ACHARD, C. H., et al. *Ann. d'Anat. Path.*, 1931, **8**, 1160.
2. ARNDT, H. J. *Verhandl. d. deutsch. pat. Gesellsch.*, 1931, **26**, 243.
3. CRAMPTON, E. W. *J. Nutrition*, 1947, **33**, 491.
4. DICK, G. F. and LEITER, L. *Amer. J. Path.*, 1941, **17**, 741.
5. GELLHORN, A. et al. *Proc. Soc. exp. Biol. Med.*, 1946, **61**, 25.
6. HESTON, W. E., LARSEN, C. D., and DERINGER, M. K. *J. Nat. Cancer Inst.*, 1945, **6**, 41.
7. KUCZYNSKI, M. H. *Virchows Arch.*, 1922, **239**, 185.
8. LETTERER, E. *Beit. z. path. Anat. u. z. allg. Path.*, 1926, **75**, 486.
9. PARSONS, L. D. and TURNBULL, H. M. *J. Path. Bact.*, 1945, **57**, 45.
10. RINEHART, J. F., CONNOR, C. L., and METTIER, S. R. *J. exp. Med.*, 1934, **59**, 97.
11. SMETANA, H. *Bull. Johns Hopkins Hosp.*, 1925, **37**, 383.
12. TAKEDA, K. and HOSHINO, K. *Trans. Soc. Path. Jap.*, 1936, **26**, 194.
13. WATANABE, Y. *Trans. Soc. Path. Jap.*, 1931, **21**, 80.

Radiophosphorus and Radiostrontium in Mosquitoes. Preliminary Report

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The possibility of employing radioactive isotopes for marking mosquitoes for subsequent recognition has led to a study of behavior of P^{32} and Sr^{90} in colonized *Aedes aegypti*, with a view to developing techniques by which such marking might be applied to large numbers of mosquitoes under field conditions. The usual methods of marking involve relatively drastic procedures, such as dusting and spraying the captive adult mosquitoes before

¹ Supported jointly by the Medical Department of Nigeria, the Colonial Medical Research Service, and the International Health Division of The Rockefeller Foundation.

release, and thus subjecting them to considerable manipulation and trauma.

The ideal marking procedure should insure (1) ease of application to large mosquito populations; (2) minimal manipulation, preferably none at all; (3) ease of recognition of the marked mosquitoes without killing them, when this is desired; (4) certainty of persistence of the marking throughout the life of the mosquito; (5) freedom from deleterious biological influences.

It seemed that all of these conditions could probably be met by a radioactive element, provided it were bound by the mosquito tissues and not excreted. Sufficient radiation energy to be detected readily by the usual equipment would be essential, and the life of the radioactive isotope would need to be long enough to permit ready detection throughout the life of the insect.

Both P^{32} and Sr^{90} were found to be absorbed by the larvae and to be carried through the pupal stage into the adult. For marking purposes P^{32} was used as Na_2PO_4 and Sr^{90} as $SrCl_2$. It was found that concentrations giving radioactivities of 10–20 $m\mu c$ per cc in the larval baths produced mosquito radioactivities of from 2 to 16 $m\mu c$, depending upon the concentration of the larvae and the conditions of feeding. A density of 5 larvae per cc gave satisfactory development provided adequate food was supplied.

Both isotopes showed similar behavior in that they were absorbed chiefly during the fourth stage and were not subsequently excreted from the adult body. The only significant loss was through egg laying, by which an appreciable fraction of P^{32} and a much smaller proportion of Sr^{90} would be passed out. There was no absorption by pupae.

There were no evidences of toxicity with a bath radioactivity of 0.2 μc per cc, which is about 100 times that needed for marking purposes. As the intensity of radioactivity was increased, the first indication of abnormality was the failure of mosquitoes to produce eggs. On dissection of such mosquitoes, no ovaries could be identified. This occurred especially with P^{32} at a radioactivity of about 200 $m\mu c$ per mosquito. With still higher bath radioactivity, pupation did not occur.

Within the range of radioactivities used for marking purposes, there were no significant differences in longevity of the radioactive mosquitoes and their controls. With both isotopes, however, the females exhibited about twice the radioactivity of the males from the same baths.

Dissection experiments showed a similar distribution of the two isotopes in the mosquito body, a distribution which was independent of the total amount of radioactivity shown by the mosquito. Of especial interest was the finding that nearly 40% of the total radioactivity in female *Aedes aegypti* mosquitoes could be found in the eggs, while there was practically none in the wings.

Four field experiments were made involving the release of radioactive *A. aegypti* and their subsequent capture.

In the two largest releases Sr^{90} was used; in the others P^{32} was employed. Photographic trays were used for the larval baths. It was found desirable to allow the larvae to develop to the third stage in other containers so that overcrowding did not occur until they were reaching the fourth stage, which was passed in the radioactive bath, where pupation and emergence also took place. For the first two experiments, pupae were counted into clean water and allowed to emerge from that container. Later, it was concluded that this method was too laborious and that it was possible to estimate the number emerging by dividing the amount of radioactive material disappearing from the bath by the average mosquito radioactivity.

The essential results of these field experiments are given in Table 1.

TABLE 1
SUMMARY OF FIELD EXPERIMENTS WITH RADIOACTIVE *Aedes aegypti*

| No. | Isotope used | Mosquitoes released, No. | Radioactivity bath $\mu c/cc$ | Radioactive mosquitoes captured | Mean mosquito radioactivity $m\mu c$ | Maximum age, days | Maximum distance, ft |
|-----|--------------|--------------------------|-------------------------------|---------------------------------|--------------------------------------|-------------------|----------------------|
| I | P^{32} | 5,000 | 0.023 | 15 | 15.8 | 9–13 | 450 |
| II | P^{32} | 9,221 | 0.085 | 27 | 2.4 | 3–13 | 850 |
| III | Sr^{90} | 10,000 (?) | 0.024 | 34 | 4.2 | 15–20 | 1,100 |
| IV | Sr^{90} | 252,000 | 0.019 | 240 | 1.8 | 28 | 3,800 |

Catches were made at a series of stations placed around the compass at varying distances from the release point. Human bait was used and the usual catching time was from 6 to 8 o'clock in the evening. Radial disposition of the stations was found most satisfactory for the first few catches of an experiment; later, irregular arrangements were used when it was desired to pay especial attention to certain areas.

It was found in field experiment IV that where the mosquito density in the bath is of the order of 5 per cc, rapid depletion of the radioactive material occurs, so that by measuring the radioactivities of mosquitoes emerging on successive days, it is possible to use the curves so obtained to determine the day of emergence and hence the age of mosquitoes caught subsequently. Also, where there is proper placing of the catching stations, the proportions of radioactive and nonradioactive mosquitoes of the species studied may be used with the estimate of the number emerging to give an approximation of the total population in the area.

It was found in these experiments that the mosquitoes were distributed largely by wind drift rather than their own flight, although the latter contributed. High winds and rains, however, tended to shorten the life span and thus limited the spread. Males and females traveled approximately the same distances, but the males had a survival time of only a few days.

Comments and Communications

On the Price of Books: A Publisher's Reply to Mr. Lowry

In your issue of the 22nd April, John R. Lowry protests against the present high prices of scientific books and suggests that books might be issued "in both unbound and bound form."

It has frequently been suggested that the publication of books in paper bindings would result in a considerable saving, but this is in fact not the case. The saving in most instances would amount to only a few cents, since the greater part of the binding cost is in the folding and collating of the sheets and the sewing of the signatures; this operation has to be performed by the binder whether the casing is paper or boards.

The manufacturing cost of many books has doubled in recent years, as your correspondent rightly points out. The list price charged by publishers has been increased by a much smaller proportion. I believe that books show a smaller increase in price over the prices of ten years ago than almost any other commodity on the market.

F. RONALD MANSBRIDGE

Cambridge University Press
American Branch

Precipitation Cycles

Recalling my own papers (Smithsonian Misc. Coll. Vol. 104, Nos. 3, 5, 1944; Vol. 111, No. 4, 1949) a letter from E. Frasselle, translated from the French, is of much interest:

I have much pleasure in informing you that I am verifying the influence of the cycle of 27 days on the precipitation registered at Shangugu (Costermansville) in Ruanda (Afrique Orientale).

The graph enclosed [Fig. 1] is computed from rainfall data of this station for 41 cycles from 4-1-1946 to 14-1-1949, as tabulated below. [The table is here omitted.]

I fixed the zero of the first cycle at 4-1-1946, because it represents the phase of maximum rainfall for the cycle as

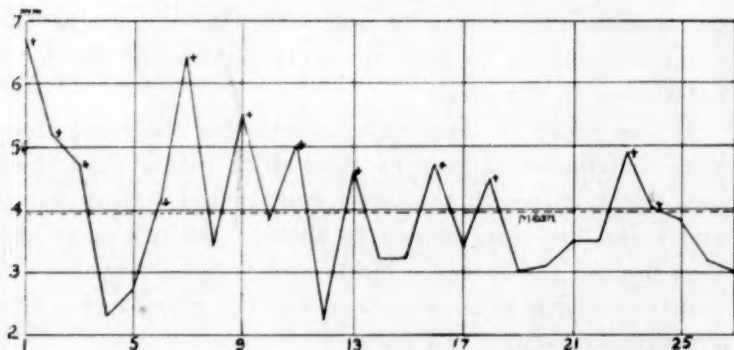


FIG. 1. The 27-day cycle in precipitation at Shangugu, lat. $2^{\circ}30'S$; long. $28^{\circ}54'E$; Alt. 1476 m. Ordinates, mean rainfall per day (mm) on cycle dates (abscissas) from 41 cycles. "Preferred" cycle dates +.

indicated by the mean of the 41 cycles. This day would therefore correspond to the twelfth day of your cycle for Washington, Smithsonian Misc. Coll., Vol. 104, No. 3.

In spite of the restricted number of cycles (41) used to establish my mean curve, the general correspondence of my results with yours is striking, and I cannot hide from you my satisfaction therein. This seems to me to have a great importance when one considers that Washington is situated in the Temperate Zone and Shangugu in the tropics.

I am about to publish a paper on the subject in which I give the ratio of expected average rainfall on preferred days to that on all others as 1.60. This follows from the graph enclosed.

The matter was further referred to in my paper before the National Academy of Sciences (*Science*, 1949, 109, 436).

C. G. ABBOT

Smithsonian Institution

Anode-Cathode Labeling in Electrochemistry

There has been much controversy over the use of the terms "anode" and "cathode" in the labeling of the electrodes in electrolytic and galvanic cells. From the standpoint of first year college students, as well as workers in the field, this has been an everlasting problem, always giving rise to doubt and uncertainty.

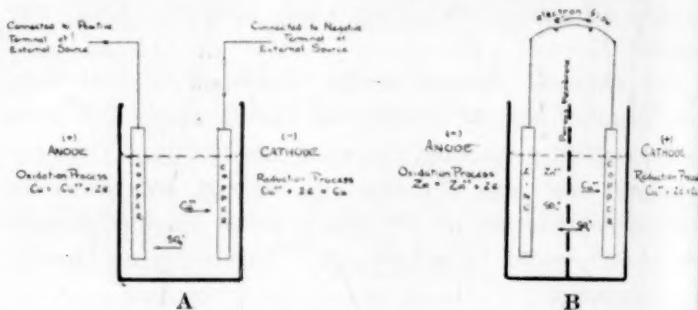


FIG. 1. A—Electrolytic cell. B—Galvanic cell (the Daniell cell).

The use of the terms with respect to an electrolytic cell, Fig. 1A, is not controversial, since it follows directly from Faraday's work on electrolysis. During electrolysis the electrode to which the anions migrate is termed the anode and that to which the cations migrate is termed the cathode. The electrode connected to the positive pole of the external circuit is the anode and that which is connected to the negative pole is the cathode.

On carrying over the use of these two terms to the galvanic cell, either one of two definitions must be followed: (1) the anode is always positive and the cathode always negative, or (2) the anions migrate to the anode and the cations migrate to the cathode. Both of these statements hold true for the electrolytic cell.

If the first statement is accepted, then in the case of the Daniell Cell (a galvanic cell), $Zn/ZnSO_4//CuSO_4/Cu$ the zinc electrode is the cathode and the copper electrode is the anode. This being the case, then the second statement cannot be true for the galvanic cell. From Fig. 1B, it can be seen that the copper ions migrate to the vicinity of the copper electrode and this we have termed anode according to statement 1. Confining ourselves strictly to Faraday's work and using these notations with respect to the galvanic cell, we would label the copper

electrode as the cathode, for it is to this electrode that the cations, the copper ions, are migrating. No mention has yet been made of positive and negative electrodes. Actually, an electrode is negative only because it is more negative than the other electrode in the system.

Using the second definition, it is immediately apparent that the terms now indicate the chemical processes occurring in the vicinity of the electrodes—namely, oxidation in the vicinity of the anode and reduction in the vicinity of the cathode. It would seem better from the chemical point of view to label the electrodes with respect to the chemical processes occurring than by any other terms. Oxidation processes will always occur in the vicinity of the anode and reduction processes will always occur in the vicinity of the cathode if this definition is followed in the labeling of both electrolytic and galvanic cells. There can be no mistaking the processes of oxidation and reduction, since they can be defined in terms of electron loss and electron gain, respectively.

Affixing the terms positive and negative to the electrodes would be a very simple matter. In the electrolytic cell, that electrode to which electrons are being admitted is termed the negative electrode (cathode), for it is more negative than the other electrode in the cell. In the galvanic cell, that electrode at which electrons are being liberated is termed the negative electrode (anode), for it is more negative than the other electrode in the cell. The chemical processes occurring at the negative and positive electrodes in the electrolytic and galvanic cells will be different, but the processes occurring at the anode and the cathode will be the same. The diagram shown

of the electrolytic and galvanic cells make clear the notation and charge of each electrode.

PAUL DOIGAN

New York University

Corrections

In the paper "Preliminary Observations on the Biological Effects of Radiation on the Life Cycle of *Trichinella spiralis*" by Alicata and Burr (*Science*, 1949, 109, 595) the reports of earlier observations by E. E. Tyzzer and J. A. Honeij (*J. Parasitol.*, 1916, 3, 43), B. Schwartz (*J. Agric. Res.*, 1921, 20, 845), and others, on the deleterious effects of radiation on the reproductive tissue of *T. spiralis* were inadvertently omitted from the list of references.

JOSEPH E. ALICATA

University of Hawaii

Agricultural Experiment Station

A typographical error in Table 1 of my paper "The Validity of the Use of Tracers to Follow Chemical Reactions" (*Science*, 1949, 110, 14), under the entries for chlorine makes the estimated maximum ratios for the tracers Cl^{36} and Cl^{38} somewhat ambiguous. The stable isotopes should be written as Cl (natural abundance). The ratios were calculated for reactions with the tracers Cl^{36} and Cl^{38} in systems containing chlorine of natural isotopic abundance. Due attention has been given to the fact that the Cl^{35} and Cl^{37} will react at different rates.

JACOB BIGEISEN

Brookhaven National Laboratory

Book Reviews

Kinematic relativity: a sequel to relativity, gravitation and world structure. E. A. Milne. New York: Oxford Univ. Press; Oxford, Engl.: Clarendon Press, 1948. Pp. vi+238. \$6.50.

This book is a presentation of the author's theory of cosmology and physics. It is a sequel to his study *Relativity, gravitation and world structure* (1935), but can well be read independently from the earlier volume. It is a fascinating treatise, centered around a brilliant idea, excellently presented and showing unusual skill in the elaboration of some of the details. Even though the reviewer could not agree with all parts of the book, his admiration never slackened for the scope of the work and the wealth of results obtained by the author with the help of only a handful of collaborators.

The central idea of Milne's theory is a restatement of Mach's principle (cf. p. 3) that the laws of nature are

a consequence of the contents of the universe. Our expanding universe is, however, an ordered structure, consisting of galaxies moving as if they had originated at a certain time at a common point (the "origin of the world") and moved away from each other henceforth. There is, therefore, it can be claimed, no purpose in establishing laws of motion which would be valid in an arbitrary type of universe or in setting up laws of invariance which disregard the structure of our universe. In our universe, a definition of absolute rest, at every point of space time, can be obtained by considering the motion of the galaxies at that point. The coordinate systems in which matter, on the average, is at rest along the time axis are, according to Milne, preferred over other coordinate systems, but are mutually equivalent. The equivalent coordinate systems form a sixparametric manifold: three parameters are necessary to give the "average material point" whose world line coincides with the time axis of the coordinate system, and three parameters give the orientation of the space axes. The equivalent coordinate systems thus form a much smaller manifold than in Einstein's special theory of relativity, in which ten parameters are necessary to describe an inertial coordinate system. In Milne's theory, coordinate systems

which have a common origin ($x=y=z=t=0$), but are in motion with respect to each other, are not equivalent any more unless the common origin is the origin of the world. If this is not the case, the coordinate system which is at rest with respect to the average motion of matter at its origin is preferred. Mathematically, the group of Milne's equivalent coordinate systems is the homogenous Lorentz group (with the origins at the origin of the world); for Einstein's equivalent coordinate systems it is the inhomogeneous Lorentz group. This restriction of the equivalent coordinate systems to a smaller manifold than in Einstein's special theory is the basic postulate of Milne's theory.

The derivation of the transformation between Milne's preferred coordinate systems (i.e., the derivation of the Lorentz transformation) is carried out in part I of the book, without making use of the usual devices of rigid rods and perfect clocks, by a brilliant piece of reasoning. The assumption is introduced that it is possible to regraduate the time scales of all preferred coordinate systems in such a way that if the light signal from A 's clock at time t reaches B 's clock at time t' (by B 's clock) then the signal from B 's clock at time t also reaches A at time t' (by A 's clock). A set of clocks satisfying the above condition and each moving with the average motion of matter at its position is called an equivalence. The existence of equivalences essentially makes space "flat" in the sense of Reimann-Einstein—an assumption which has been criticized a great deal, but which is certainly at least a permissible assumption.

The postulate of the existence of equivalences does not fix the time scales of all observers uniquely. On the contrary, it is shown that one of the observers can renormalize his clock by introducing a new time measure $T=f(t)$, if the other observers do likewise. Milne considers in particular two time measures: the t -measure corresponds most closely to the time scale of conventional physics and has been used in the above qualitative discussion, while the τ scale is obtained by setting $\tau = t_0 \ln t / t_0$ with an arbitrary t_0 . In t -measure the transformation between coordinate systems is by Lorentz's formulae, with the origin of the world corresponding to $t=0$. In τ -measure the origin of the world was at $\tau = -\infty$ and it is shown that actually the τ -measure coordinate systems can be considered to be at rest with respect to each other.

Milne's use of equivalences instead of rigid measuring instruments for the definition of his coordinate systems, as well as his emphasis on an elastic time scale, are, in the opinion of this reviewer, distinct advances in the epistemological sense. However, a study of his arguments fails to support the author's claim (p. 32) that he has not used the results of the experiments which conventionally go into the establishment of Lorentz's formulae. Similarly, the reviewer found it disturbing that the possibility of the renormalization of the clocks of all observers so that the equivalence axiom is satisfied for any pair of them has not been introduced more explicitly as an assumption.

This discussion of part I of Milne's book may indicate the stimulating and thought-provoking character of all four parts. Part II deals with the dynamics of a free particle. In the conventional special theory of relativity, Newton's first law is an immediate consequence of the equivalence of all coordinate systems which are in uniform motion with respect to each other. This is not the case in the present theory and the analogue of Newton's first law actually does not follow from the axioms introduced in part I. The most important result of part II is that Newton's first law in its original form is valid only in the coordinate systems which use τ -measure. The author attempts to give a derivation of this result, but his proof appears to be not much more than a plausibility argument. The apparent accelerations in t -measure are interpreted as the gravitational effect of the substratum, by assuming that the gravitational constant increases linearly with t .

The most interesting section of part II deals with the dynamics of light. The observed magnitude of the red shift of receding nebulae, which causes difficulties with the conventional theory, appears as a natural consequence of the author's concepts. The reviewer would have liked to see at this point a discussion of the basic experiments which have led to the special theory of relativity, such as the Michelson-Morley and the Trouton-Noble experiments, on the basis of the theory here presented. It would have been particularly important to discuss these experiments from the point of view of an observer who is in motion with respect to Milne's preferred coordinate systems, i.e. an observer who uses a coordinate system which is a preferred one in Einstein's theory of relativity but not in Milne's. The reviewer must also admit that he completely failed to understand section 133, dealing with the frequency of atomic transitions. It seems to him to follow from the argument presented on page 120 that light emitted by one galaxy and reflected back by a distant one cannot be absorbed at all by the original galaxy; as a result of the two kinds of Planck's constants, atoms which have the right resonant frequency do not possess the proper energy differences between their stationary states and conversely. This certainly could not have been the author's meaning.

The most interesting sections of part III deal with the structure of spiral nebulae. Again, the claim can be made that Milne's theory accounts better for the observations than does the conventional picture. Finally, in part IV, dealing with electrodynamics, the author ventures rather far into the field of speculation.

This summary should suffice to give an idea of the scope and significance of Milne's book. It is a book of many ingenious ideas, the concept of the change of the fundamental constants with time being only one of the author's original contributions. The reviewer suspects that most readers will disagree with some details of the book, just as he did. He hopes, however, that they also will find it highly interesting and stimulating, if somewhat too mathematical reading.

E. P. WIGNER

Princeton University

NEWS

and Notes

M. F. Ashley Montagu has resigned as associate professor of anatomy at Hahnemann Medical College, Philadelphia, to become chairman of the newly created Department of Anthropology at Rutgers University, New Brunswick, New Jersey, effective July 1.

James F. Bonner, professor of biology at the California Institute of Technology, has been elected president of the American Society of Plant Physiologists. He succeeds **Donald B. Anderson**, North Carolina State College.

Theodore L. Althausen, professor of medicine at the University of California Medical School, will spend six months at the Walter and Eliza Hall Institute for Medical Research at the Royal Melbourne Hospital in Australia. Dr. Althausen will conduct research in diseases of the liver and disturbances of intestinal absorption.

William Walter Greulich, professor of anatomy at Stanford University, has been appointed executive head of the Department of Anatomy to succeed **Charles Haskell Danforth**, who is retiring at the expiration of the academic year.

Hans Ris, associate in physiology at the Rockefeller Institute, has been appointed a professor in the Department of Zoology at the University of Wisconsin.

Douglas M. Whitaker, dean of graduate study at Stanford University, will attend, under the auspices of the Rockefeller Foundation and the U. S. Military Government, a series of conferences in Germany on German universities. Dr. Whitaker will serve as consultant on teaching and research in the biological sciences.

Lee E. Farr, director of research and physician-in-chief of the Alfred du Pont Institute of the Ne-

mours Foundation in Wilmington, Delaware, has been appointed head of the Medical Department at Brookhaven National Laboratory.

Visitors

Recent visitors at the National Bureau of Standards included: **Lars Gunnar Sillen**, research associate, University of Stockholm, Sweden; **Douglas R. Hartree**, research associate, The Cavendish Laboratories, Cambridge, England; **T. H. Morton**, of Cortaulds Limited, England; **Herman Bertling Hederra**, professor of applied seismology, University of Chile, Santiago; **Tong H. Ahn**, director, National Central Research Laboratory, Korea.

Julio Enrique Toral, pediatrician at the School of Medicine of the University of Cuenca, Ecuador, after a brief visit to Washington, D. C., will make a tour of medical schools and centers throughout the country to confer with colleagues in his field.

Yngve Ohman, of the Stockholm Observatory at Saltsjobaden, Sweden, holds a research associate appointment at the High Altitude Observatory of Harvard University and the University of Colorado at Boulder. Dr. Ohman will continue his research at the observatory until October.

Grants and Awards

The 1949 Gold Medal of the American Society for Metals will be presented to **Edgar C. Bain**, vice president of Carnegie-Illinois Steel Company, on October 20, during the 31st National Metal Congress and Exposition.

The \$1,000 Eli Lilly Award in Biological Chemistry has been granted to **Irving M. Klotz**, associate professor of chemistry at Northwestern University. Dr. Klotz is being honored for his research on proteins. The award will be presented on September 19, at the Atlantic City meeting of the American Chemical Society.

The Geological Society of South Africa has extended an invitation of

membership to **George B. Barbour**, dean of the College of Liberal Arts at the University of Cincinnati. The society is honoring Dr. Barbour for his research in South Africa on prehistoric man.

The 1949 Award of Merit of the American Hospital Association was granted to **Claude W. Munger**, former director of St. Luke's Hospital in New York. Dr. Munger is a former president of both the association and the American College of Hospital Administrators.

The Francis J. Clamer Medal of the Franklin Institute of Pennsylvania has been awarded to **William Hume-Rothery**, lecturer in metallurgical chemistry at Oxford, in recognition of his work in determining and interpreting the structure and behavior of metallic equilibrium systems.

Fellowships

Five \$1,500 predoctoral fellowships for the study of the applications and implications of atomic energy are available at the University of Michigan for 1949-50. Applications will be accepted through August 15 and appointments will be made by September 1. Appropriate research for the fellowships should fall into one of the following divisions: the use of radioactive isotopes in biological, physical, and engineering sciences; the physical, mathematical, or chemical aspects of nuclear theory; the social, philosophical, legal, or economic aspects of nuclear energy; and educational needs of this field. Inquiries may be addressed to **Dean Ralph A. Sawyer**, Horace H. Rackham School of Graduate Studies, University of Michigan, Ann Arbor, Michigan.

The Department of Biology of Emory University, Georgia, has inaugurated a graduate program in biology involving advanced studies and research leading to the Ph.D. degree. The program represents an enlargement of the graduate program of studies leading to the M.A. degree, which has been offered in biology at the university for 30 years. Special emphasis will be

placed on cellular biology. Two nine-month fellowships for Ph.D. candidates are available, one of \$1,200 and another of \$1,000. Several fellowships and assistantships with stipends of \$900 are available at the M.A. level.

The National Research Council's Committee on Growth, acting for the American Cancer Society, is accepting applications for grants and fellowships. Applications for new grants in cancer research are acceptable until *October 1*. Investigators now receiving grants will be notified regarding applications for extension. Final decisions on applications will be made in most cases soon after February 1, 1950, and grants approved at that time will become effective July 1. Fellowship applications may be submitted at any time. Those received prior to November 1 will be acted upon by the committee in December, those received between November 1 and March, in April. Fellowships will begin July 1, 1950, unless otherwise indicated by the applicant. Communications should be addressed to the Executive Secretary, Committee on Growth, National Research Council, 2101 Constitution Avenue, Washington 25, D. C.

Colleges and Universities

Columbia, Harvard, Princeton, and Yale Universities will receive \$150,000 each for scientific education and research during the academic year 1949-50 under the first distribution of the \$34,000,000 Eugene Higgins Scientific Trust.

At Columbia, the largest single allocation of the initial grant will be used for work on nuclear, atomic, and molecular physics in the Pupin Laboratories, and at the new cyclotron plant at Nevis. The Harvard program will include expansion of basic research projects in medicine and dental medicine. Princeton's Departments of Science and Engineering will use the funds for support and expansion of research projects in physical and analytical chemistry, and chemical and electrical engineering. The Yale grant will be applied to fields of medical research,

including a major project in microbiology.

The Higgins Scientific Trust was established by the late Eugene Higgins, son of a pioneer textile manufacturer. Benjamin Strong, president of the United States Trust Company of New York, is chairman of the board of control, which is composed of the presidents of the four beneficiary universities.

Ohio State University has received a gift of \$9,000 from the Edward Orton, Jr. Ceramic Foundation for research in ceramic engineering. The study will be conducted by H. G. Wolfram, former vice president of Pemo Corporation, Baltimore, Maryland, manufacturers of porcelain enamels, who will join the university's Department of Ceramic Engineering as research associate.

Meetings and Elections

The American Institute of Chemical Engineers will hold a regional conference in Montreal, Canada, September 6-9. The program will include discussion of Canadian natural resources, the economic significance of Newfoundland, the development of water power, and the aluminum industry. Papers on oil technology and metallurgy will also be presented. A complete program can be obtained from the American Institute of Chemical Engineers, 120 East 41st Street, New York City 17.

Thermodynamics in physical metallurgy will be the subject of a two-day symposium, sponsored by the American Society for Metals, to be held October 15-16 in Cleveland's Public Auditorium preceding the opening of the 31st annual National Metal Congress and Exposition, October 17-21. Clarence Zener, professor of physics, Institute for the Study of Metals, University of Chicago, is chairman of the symposium series and will speak on the "Contributions of Statistical Mechanics" during the morning session, October 15. Among the other participating scientists are P. W. Bridgman, Hollis Professor of Mathematics, Harvard

University; A. W. Lawson, associate professor of physics, Institute for the Study of Metals, University of Chicago; John Chipman, professor and head of the Department of Metallurgy, Massachusetts Institute of Technology; and Frederick Seitz, professor and head of the Department of physics, Carnegie Institute of Technology.

A symposium on small angle X-ray scattering will be held at the University of Missouri in Columbia, on October 21 and 22. Contributed papers will be welcomed. The tentative schedule thus far includes papers by R. D. Dragsdorf, A. Heyn, P. J. Kaesberg, P. C. Sharrah, G. Vineyard, and K. L. Yudowitch. On October 21, P. Debye, of Cornell University, will give an O. M. Stewart Lecture on "The Interpretation of Scattering Experiments in Terms of Structure," in which he will include references to recent work on light scattering. Those who are interested in attending the symposium or in presenting a contributed paper should write to Prof. George H. Vineyard, Department of Physics, University of Missouri, Columbia.

The 96th convention of the Electrochemical Society will be held at the La Salle Hotel, Chicago, October 12-15. Symposia on electrodeposition, corrosion, and organic electrochemistry, and special round table sessions on batteries and organic electrochemistry are being scheduled. Additional information may be obtained by writing to Henry B. Linford, Secretary of the Electrochemical Society, 235 West 102nd Street, New York 25.

The annual meeting of the **American Society for the Study of Arteriosclerosis** will be held November 5-7 at Hotel Knickerbocker, Chicago. Information may be obtained from Cowles E. Andrus, Program Chairman, 24 East Eager Street, Baltimore, Maryland.

The Annual Conference of Midwestern Parasitologists elected the following officers for 1949-50 at its first conference, held at the University of Wisconsin June 20-21: presiding officer, R. V. Bangham,

Wooster College; secretary-treasurer, R. J. Porter, University of Michigan.

Autocorrelation. Because of the extensive interest in uses of autocorrelation analysis for scientific problems, the Woods Hole Oceanographic Institution organized a symposium for the Office of Naval Research on June 13 and 14. The purpose of the conference was to present and interpret results of applications of the relatively new and powerful method of autocorrelation analysis of finite amounts of data. Since the applied mathematician has the job of solving the problem as it comes to him from nature, he must generally modify the mathematical methods he proposes to use in such a fashion as to fit the data. For instance, in the case of time records of natural phenomena, the resulting time series is not stationary, its mean is usually not zero, and the series is seldom long enough to be considered infinite. Consequently, experimentation with theoretical mathematical procedures is essential if the resulting representation is to possess physical significance. It is, for instance, the application of certain mathematical procedures to time series analysis, where the theoretical conditions are not fulfilled, that has resulted in claims of a bewildering variety of periods or cycles which cannot be substantiated.

The underlying concept of autocorrelation analysis is that the behavior of a physical phenomenon, and of the dynamics causing it, is directly associated with the problem of predicting the future course of a time series from its past behavior. Also, the distance into the future which the phenomenon may be accurately forecasted gives an indication of the amount of dynamics associated with the phenomenon itself. This procedure is to be distinguished from one in which a mathematical theory is set up, as, for instance, that obtained by application of periodogram or Fourier series analysis to time series, but which will have a physical significance only if it can be extrapolated into the future.

Autocorrelation analysis is em-

ployed both as a prediction mechanism and as a means of generalized harmonic analysis. The correlogram and the Fourier transform of the autocorrelation functions into power spectra serve to describe finite amounts of basic data by measuring the physical properties of period, amplitude and damping coefficients. It can be shown that the autocorrelation function may be obtained from the spectrum of the series, and the spectrum may also be obtained from the autocorrelation function.

Edwin B. Wilson acted as chairman during the two-day session at Woods Hole. Papers were given by Edwin B. Wilson, Y. W. Lee, David Middleton, G. P. Floyd, John W. Tukey, Philip Rudnick, A. T. McNish, George P. Wadsworth, Carl Eckart, and H. R. Seiwel. The proceedings were recorded and are in process of editing for publication.

H. R. SEIWELL

Committee of the National Academy of Sciences on the Investigation of Cortisone.

The recent publication by Hench, Kendall, Slocumb, and Polley of the dramatic effectiveness of the adrenal cortical steroid, Cortisone (first isolated by E. C. Kendall), in the treatment of rheumatoid arthritis has posed an important problem of distributing the very limited amount of that substance which will be obtainable during the remainder of this year. Originally obtained from the cortex of the adrenal gland, it is now being prepared synthetically from a bile acid. While the value of Cortisone in controlling the symptoms of rheumatoid arthritis is regarded as established, much remains to be learned concerning its possible untoward effects, its usefulness in other diseases, and the mechanism of its action. It has been decided, therefore, that the small amount which can be made during the last five months of 1949 shall be used only for clinical and experimental research. It will be made available to those investigators who are in the best position to provide the infor-

mation vitally needed to insure its safe and effective use.

The Research Corporation, a non-profit organization which administers patents in the interest of public welfare and for the furtherance of scientific research, has aided in the development of the synthetic processes for making Cortisone. The corporation will continue to further the development of these processes and to stimulate research on the mechanisms of action of the compound. In fulfilling these functions, the Research Corporation has requested the president of the National Academy of Sciences to appoint a Committee on Investigation of Cortisone, with assurance that its recommendations will be accepted as final with respect to all of the available 1949 supply.

The membership of the committee, appointed with the sanction of the Council of the Academy, is as follows: Chester S. Keefer, chairman; Hans T. Clarke, E. A. Doisy, Robert F. Loeb, C. N. H. Long, E. K. Marshall, Jr., Joseph T. Wearn. David E. Price has been appointed by the Acting Surgeon General to act as liaison between the committee and the U. S. Public Health Service.

The committee is planning arrangements designed to utilize to the fullest possible extent the resources of the National Research Council and the information and advice of experienced and competent investigators in the United States and Canada. Not only will the fields of rheumatism and other diseases for which relief may be anticipated continue to be investigated, but also fields of physiology and pharmacology which are basic to fuller understanding and further advance.

While the Academy has no funds with which to buy Cortisone or to support investigations, it is confidently expected that the needed funds will become available from both public and private sources.

The Academy committee has accepted this responsibility because of the deep conviction that a new discovery of the greatest importance to the health and welfare of countless people has been made and that it is vital to promote its most rapid

and intelligent development.

Applications for a supply of Cortisone must be submitted on a form that can be obtained from the chairman of the committee, Dr. Chester S. Keefer, 2101 Constitution Avenue, Washington 25, D. C. It must be emphasized that consideration will be given only to requests from institutions where adequate facilities for investigation and clinical control are available.

The Atomic Energy Commission has announced that cyclotron-produced radioisotopes are to be made available to U. S. researchers, to augment the present distribution of isotopes produced by the Oak Ridge pile. Although the pile far surpasses the cyclotron in quantity production, the cyclotron produces a wider variety of isotopes. Because no one laboratory can satisfy the demand without seriously interfering with its research program, arrangements for irradiation will be made with a number of institutions.

The initial group will include the Massachusetts Institute of Technology, the University of Pittsburgh, Washington University at St. Louis, and the Crocker Radiation Laboratory at the University of California. The Department of Terrestrial Magnetism of the Carnegie Institution will participate in the general program.

Processing of irradiated targets will be carried out by the Oak Ridge National Laboratory, in facilities already provided for handling reactor-produced isotopes, and the commission's Isotopes Division will handle allocation. Cyclotron-produced isotopes are relatively costly and the commission will subsidize the program to some extent. All isotopes are made available free of production charges for cancer research.

At first only isotopes having half-lives of more than thirty days will be distributed. Included in this group are: 43-day beryllium 7, 3-year sodium 22, 44-day iron 59, 4-year iron 55, 250-day zinc 65, 90-day arsenic 63, and 56-day iodine 125. Others will be added later.

Distribution under the new program will be limited to the U. S.

because cyclotrons are in operation in many other countries and the isotopes they produce are more readily available abroad than pile-produced isotopes.

Judges in the **Third Annual International Photography-in-Science Salon** were announced today by *The Scientific Monthly*, which, in cooperation with the Smithsonian Institution, sponsors this annual contest. Merle A. Tuve, of the Carnegie Institution, will be the judge for the physical sciences; Ronald Bamford, of the Department of Botany, University of Maryland, for the biological sciences; A. A. Teeter, recently of Charles Pfizer & Company, New York City, for chemistry; Emanuel Krinsky, of Polyclinic Hospital, New York City, for the medical sciences; and Alexander J. Wedderburn, of the Graphic Arts Division, Smithsonian Institution, for photography.

Entries in the competition, which was established to encourage and extend the use of photography as a basic research tool, will be received by the Editor of *The Scientific Monthly*, 1515 Massachusetts Avenue, N.W., Washington, D. C., from August 24 to September 14, 1949.

First, second, and third awards and five honorable mentions will be given in each of two divisions, black-and-white and color. The Judging Committee will consider the initiative, originality, and results obtained more than the composition and pictorial quality. All photographs must be taken for scientific purposes.

The prints selected for awards and display will be shown at the U. S. National Museum during October 1949, and at the New York Meeting of the AAAS, December 26-31, 1949. They will then go on a tour of important scientific institutions in this country and abroad.

A contribution to the CARE book program to replace scientific, professional, and technical books lost during the war years in Europe and Asia (see *Science*, July 22, p. 106) has been proposed in bills S. 1998 and H. R. 5186, recently referred to the Senate Armed Services Committee and the House Foreign Affairs Committee. The contribu-

tion is to be in an amount equal to a fund which was created during the war out of wages earned by conscientious objectors, working on farms and in hospitals. The wages were paid to the Treasury, where they were kept in a special deposit until the end of the war. On March 7, 1947, the fund, totaling \$1,245,018, was listed as miscellaneous receipts by the Treasury and technically, therefore, no longer existed as a separate fund. The Comptroller General ruled that the payments belonged to the United States but, since they were not collected from taxes, the Treasury Department indicated no objection to the appropriation of the fund for relief purposes, which is the preference expressed in an informal poll among the men whose earnings created the fund. In 1949 the National Service Board for Religious Objectors, after examination of the CARE Book Program, requested the use of this fund for replacement of war-destroyed books, as provided in the proposed legislation.

Recently Received—

Clinical Problems of Advancing Years. (Symposium presented by Smith, Kline & French Laboratories.) Smith, Kline & French, Philadelphia 1, Pa.

Our Dwindling Resources (articles relating to scientific conservation of America's resources as reprinted from *Monsanto Magazine*). Monsanto Chemical Company, St. Louis 4, Mo.

Hybrid Corn (Maize) in Theory and Practice by Gordon Haskell. John Innes Horticulture Institution, Merton Park, London, S.W.19, England. \$1.00.

Make Plans for—

Meteoritical Society, 12th annual meeting, September 6-7, University of Southern California, Los Angeles.

American Psychological Association, September 6-10, Shirley Savoy Hotel, Denver, Colorado.

Biological Photographic Association, 19th annual meeting, September 7-10, Hotel Cleveland, Cleveland, Ohio.